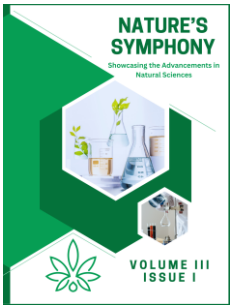
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Research Article

Knowledge, Attitude, and Practices Regarding Type-2 Diabetes Mellitus in Pakistan: A Cross-Sectional Study Using HbA1c Screening

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ABSTRACT

One of the most common chronic diseases with substantial public health and economic implications is Type 2 Diabetes Mellitus, which affects more than 400 million people globally and makes up more than 90% of all instances of diabetes. The prevalence of type 2 diabetes has increased recently in Pakistan and around the world. The present study aimed to raise awareness of diabetes among diabetic patients, healthy individuals, and pre-diabetic individuals in order to enhance self-care habits among these groups. A self-administrated online questionnaire-based survey was carried out from September 2023 to April 2024. It consisted of two sections: first was related to demographic characteristics, while the second was related to knowledge, attitude, and practices *i.e.,* KAP survey of Pakistani community. Using glycated hemoglobin (HbA1c) as the screening test, we determined the prevalence of type 2 diabetes mellitus. Disease prevalence, both overall and stratified, and its correlation with risk variables were evaluated. Among 310 responses received, results showed that 39.2% of males and 13.4% of females were affected. Obesity was found to be a significant factor in the disease incidence. Type 2 diabetes mellitus was significantly correlated with advanced age, central obesity and higher body mass index, having a positive family history, and hypertension. A negative correlation with the categorical variable of education. Therefore, in the developing countries there is a strong need to raise awareness about causative agents of type 2 diabetes mellitus among people to minimize the disease incidence.

1. INTRODUCTION

High blood sugar levels are particularly associated with diabetes, a disorder that can cause blood vessel damage and other health problems. Dysregulation of lipid, protein, and carbohydrate breakdown is a hallmark of diabetes mellitus type 2 (T2DM), which can be brought on by either reduced insulin production, insulin resistance, or both (Yang *et al.*, 2023). Among the three main forms of diabetes, type 2 diabetes is significantly more prevalent than either type 1 diabetes mellitus (T1DM) or gestational diabetes, accounting for over 90% cases (Mookpaksacharoen *et al.*, 2024). The primary cause is the gradual decrease in insulin release by pancreatic β-cells, which often occurs when skeletal muscle, liver, and adipose tissue already have insulin resistance (Nadeau *et al.*, 2016; Padhi *et al.*, 2020). Elevated HbA1c values, impaired tolerance to glucose (IGT), or impaired fasting

glucose (IFG) levels are indicative of pre-diabetes (Tura *et al.*, 2021; Ajayi *et al.*, 2023). Individuals with IGT exhibit decreased delayed (second phase) release of insulin after a meal and muscle insulin resistance, while those with IFG levels have reduced early (first phase) insulin secretion and hepatic insulin resistance. People with IFG levels have fasting blood glucose levels that are higher than normal but do not meet the criteria for diagnosis of diabetes (Jia *et al.*, 2024). The HbA1c readings in pre-diabetic people, range from 5.7% to 6.4%, and they represent a diverse population in terms of etiology and clinical characteristics (Faerch *et al.*, 2016). Every year, between 3 and 11 percent of individuals with pre-diabetes, acquire type 2 diabetes (Quiroz-Aldave *et al.*, 2023; Strati *et al.*, 2024). Many T2DM patients are asymptomatic when they are first diagnosed, but some show signs of severe hyperglycemia or even diabetic ketoacidosis (Dhatariya *et al.*, 2020). Because 30% of people with T2DM do not have proper diagnosis done for the disease and survive as it is therefore screening is crucial for at-risk persons (Defronzo *et al.*, 2015). A growing percentage of instances of T2DM are appearing at younger ages; this is characterized as early-onset T2DM, even though the disease typically first manifests in middle age or later in life (Magliano *et al.*, 2020; Strati *et al.*, 2024). Although the range of ages that constitute early onset is not well defined, there is general agreement that a diagnosis made before the age of 40 differs from one made later in life. There are serious risks associated with early-onset diabetes compared to T2DM, which appears later (Wong *et al.*, 2008). These risks include a higher risk of cardiovascular disease, an earlier death, and an apparent faster progression to microvascular complications when compared to later-onset presentations (Muilwijk *et al.*, 2019).

Pakistan is the 36th largest country by geographical reported area and the sixth most populous country in terms of population (Basit *et al.*, 2020; Malik *et al.*, 2024). Fasting plasma glucose (FPG) or 75gm OGTT are required by the American Diabetes Association criteria for the diagnosis of diabetes (Osuji *et al.*, 2023). These tests are time-consuming, require fasting, and may not always be repeatable. In 2009, the International Expert Committee on Diabetes proposed new diagnostic guidelines based on glycated hemoglobin (HbA1c), a marker of long-term glucose intake. The recommended diagnostic threshold of 6.5%, as with FPG and OGTT, was based on the risk for retinopathy at different HbA1c levels (Meo *et al.*, 2016). Prior to 2018, the first national diabetes survey in Pakistan was carried out in 1999 and published in 2007. A nationwide T2DM survey using the OGTT with a sample of the size 5433 was conducted in 1999 (Aamir *et al.*, 2019). While local medical specialists continuously believed that this statistic was overstated, the International Diabetes Federation (IDF) indicated in its fifth edition that 6.8% of Pakistani individuals aged 20 to 79 had the illness. After then, there were conflicting findings, with frequency ranging from 7.2-19.21% nationwide (International Diabetes Federation, 2015).

In this study, we used the HbA1c test to examine the incidence of T2DM in a substantial number of Pakistani people aged 20 and above. We also assessed the way the disease was distributed by age, gender, education, and geographic location, as well as Asian and Global cut-offs for blood pressure, smoking, family history, and body mass index (BMI).

2. METHODOLOGY

2.1 Survey Design

The purpose of this study was to ascertain Pakistan's T2DM management and practices. Data was collected through a self-administered questionnaire. The first section was related to

demographic study which included information about respondents, socioeconomic status, including age, education, and diabetes history. This section also included BMI, which was categorized into normal, overweight, and obese groups based on their height and weight. While the second section was a *KAP* (*i.e.,* Knowledge, attitude, and perception) survey. It included questions about diabetes knowledge, attitudes towards diabetes management, medication compliance, self-care practices, and diabetes knowledge. Participants were selected from the entire population using a *consecutive sampling technique*. The participants were included from different districts of Punjab province (Multan, Lahore, Layyah), Sindh (Karachi, Sukkur, Larkana) and Islamabad. In this study, all participants who had never checked their HbA1c before were included in the pre-diabetic category while all those patients who did not have proper diagnosed their T2DM were excluded from the group of diabetic participants.

2.2 Data Analysis

The study used socio demographic data and a blood glucose analyzer to analyze participants' blood glucose levels, combining pre-diabetic and diabetes-free variables into a single dichotomy for better diagnosis and treatment. The National Glycohemoglobin Standardization Programm certified FIA 8000 immunoassay analyzer (lateral flow chromatography colloidal gold), traceable to the diabetes control and complication trial (DCCT) reference technique (CV: 3%–5%), was used to determine the presence of diabetes by measuring the HbA1c in blood samples.

3. RESULTS

This survey focused on blood sugar reduction and diabetes care using digital methods and paper-based self-administered questionnaires. Participants were given digital links, and the data was collected through online platforms, messaging applications, and social media platforms. The data was analyzed using statistic aid to identify practices and knowledge about T2DM among the participants. Uniform data collection was ensured in the study.

3.1 Demographic Survey

In this study, response was received from 310 participants, with 60.8% males and 86.6% females being non-diabetic, 39.2% males and 13.4% females being diabetic. 96.7% of non-diabetics were related to the 15-25 age group and 60 % related to the 55+ age group. 3.3 %, 22.2 %, 43.1 %, 44.4 % and 40 % were diabetic according to age groups respectively as shown in Figure 1a.

It was found that non-diabetic individuals were more likely to be 15-25 years old, while diabetes was more prevalent among older individuals, as shown in Figure 1a. In the 15-25 years age group, 4.2 % were males and 25.5 % were females, from the 26-35 years age group 14.8% were males and 9.4 % were females, from the 36-45 years age group 13.2 % were males. The study found that females participated more in the 15-25 years age group, while males participated more in the 26-35 years age group, 36-45 years age group, 46-55 years age group, and 55+ years age group. The study found that 62.6% of married individuals were non-diabetic and 37.4% were diabetic, while 93.8% of unmarried individuals were non-diabetic and 6.2% were diabetic as shown in Figure 1b.

The study found that the prevalence of diabetes was significantly higher in individuals who were illiterate, indicating a negative correlation between education and diabetes as shown in Figure 1c. The study found that students and housewives were more non-diabetic, while employees and businessmen were more diabetic, as indicated by the graph as shown in Figure 1d. Overweight individuals were found to have a higher prevalence of diabetes, while those with lower body weight have a higher

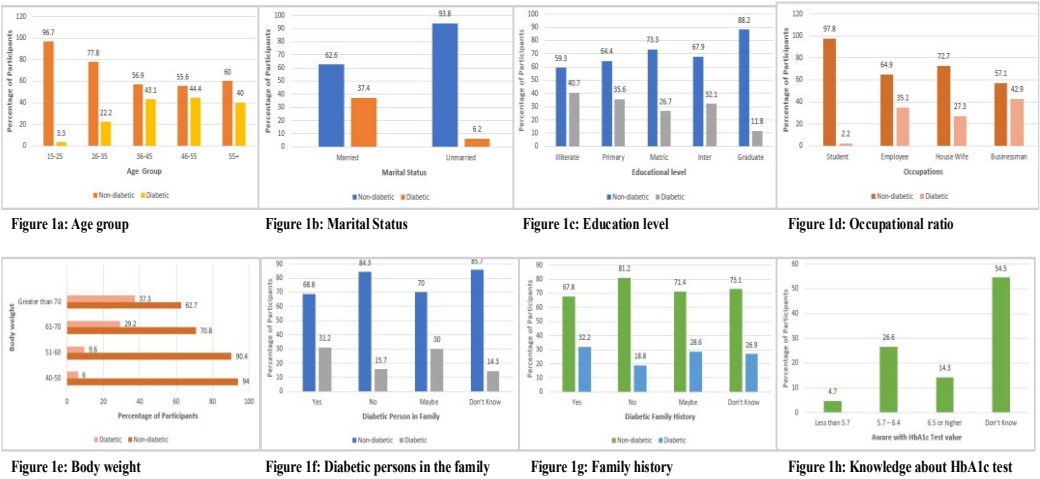


Figure 1. Diabetes control and complication trial (DCCT) prevalence by area of Pakistan, age, gender, education, and family history of diabetes (as determined by glycated hemoglobin (HbA1c) ≥6.5%).

percentage of non-diabetes as shown in Figure 1e. Majority of non-diabetic individuals, 68.8%, did not know about the presence of diabetic individuals in their family as shown in Figure 1f. Diabetic family history was more common in diabetic individuals than non-diabetic individuals as shown in Figure 1g.

3.2 Awareness of HbA1c Test among T2DM Patients and Participants

34% of participants with diabetes were identified by the HbA1c test. The remaining 66%, however, were not aware of this test. Compared to the remaining individuals, majority of participants (54.5%) were unaware of the HbA1c test result as shown in Figure 1h. Of the overall population, 42.1% were aware of the value at which a person is deemed pre-diabetic, while 45% were unaware. 37.5% of people believed it's possible to transition from pre-diabetes to normal conditions through lifestyle modifications, while 18.4% believed it's impossible. Most people (81.7%) believed that stress was the main cause of diabetes, while 48.2% believed it could be prevented by reducing stress or living in a stress-free environment. The study found that a significant percentage of individuals were aware of weight loss, increased urination, and thirst symptoms, while a significant percentage did not.

3.3 KAP Survey

Women were more active in practices like taking their medications on time, while men visited doctors more frequently and possessed a glucometer machine at home (17.4%) than women (14.2%). Compared to 8.4% of men, 12.9% of women checked their blood sugar levels. 8.1% of men and 7.7% of women visited their doctors every three months, 10.6% of women and 10% of men attended their doctors every six months, and 7.4% of men and 5.8% of women visited their doctors every twelve months. However, in the uncommon instances of rare doctor visits, 26.5% of women and 23.9% of men visited their doctors. Compared to men, women actively changed their habits to maintain their fitness. Compared to men, women were more engaged in their practices and adhered to more diet regimens to lower their blood sugar levels as described in Table 1.

Individuals with diabetes for fewer than five years were found to engage in the fundamental practices and took steps to avoid worsening it.

Compared to those who had diabetes for more than five years, they were more cautious. They were more engaged in activities like controlling their body weight, eating healthy food, getting regular exercise, and trimming their nails properly as mentioned in Table 2.

Table 1. Association of Gender with KAP survey

Parameter	Males		Females	
	Number	*Percent (%)*	*Number*	*Percent (%)*
Glucometer at Home				
Yes	54	17.4	44	14.2
No	88	28.4	77	24.8
Maybe	11	3.6	36	11.6
Regular Blood Sugar Monitoring				
Yes	26	8.4	40	12.9
No	109	35.2	96	30.9
Maybe	18	5.8	21	6.8
Regular Physician Visits				
Every 3 Months	25	8.1	24	7.7
Every 6 Months	31	10.0	33	10.6
Every 12 Months	23	7.4	18	5.8
Rarely	74	23.9	82	26.5
Medication on Time				
Yes	85	27.4	88	28.4
No	68	21.9	69	22.3
Lifestyle Modifications				
Yes	88	28.4	100	32.3
No	65	20.9	57	18.4
Proper Diet Plan				
Yes	73	23.5	89	28.7
No	50	16.1	41	13.2
Maybe	30	9.7	27	8.7
Regular Physical Activity				
Yes	75	24.2	86	26.8
No	78	25.2	71	22.9
Proper Nail Cutting				
Yes	110	35.5	109	35.2
No	29	9.4	20	6.5
Maybe	14	4.5	28	9.0
Maintaining Ideal Body Weight				
Yes	51	16.5	70	22.6
No	67	21.6	49	15.8
Maybe	35	11.3	38	12.3

Table 2. KAP survey with reference to Diabetes

	Duration of Diabetes					
	less than 5 years		*5-15 years*		*Above 15 years*	
	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)
Glucometer at Home						
Yes	27	8.7	20	6.5	6	2
No	2	0.8	3	0.9	48	15.5
May Be	20	6.5	7	2.3	5	1.6
Regular blood Sugar Monitoring						
Yes	31	10	13	4.2	4	1.3
No	3	0.9	10	3.2	51	16.5
May Be	13	4.2	7	2.3	7	2.3
Regular Physician Visits						
Every 3 Months	24	7.7	8	2.6	5	1.6
Every 6 Months	31	10	11	3.5	3	0.9
Every 12 Months	14	4.5	5	1.6	2	0.6
Rarely	6	1.9	26	8.5	4	1.3
Medication on Time						
Yes	55	17.7	24	7.7	9	2.9
No	6	1.9	40	12.9	5	1.6
Lifestyle Modifications						
Yes	54	17.4	20	6.5	9	2.9
No	10	3.2	41	13.2	5	1.6
Proper Diet Plan						
Yes	52	16.8	13	4.2	6	1.9
No	8	2.6	31	10	5	1.6
May Be	12	3.9	9	2.9	3	0.9
Regular Physical Activity						
Yes	49	15.8	15	4.8	6	1.9
No	15	4.8	46	14.8	8	2.6
Proper Nail Cutting						
Yes	55	17.7	20	6.5	4	1.3
No	5	1.6	19	6.1	7	2.3
May Be	21	6.8	5	1.6	3	0.9
Maintaining Ideal Body Weight						
Yes	32	10.3	13	4.2	8	2.6
No	15	1.6	37	11.9	3	0.9
May Be	26	8.4	2	0.6	3	0.9

5. DISCUSSION

Understanding the patient and their disease is crucial for managing T2DM, as patients must make daily decisions and perform difficult tasks to achieve sufficient glycemic control (Galicia-Garcia *et al.*, 2020; Ansari *et al.*, 2023). Lifestyle modifications, with or without pharmacological treatments, are the mainstay of T2DM treatment, with frequent follow-up monitoring. Insulin release can be modulated and glucose regulation improved by food, exercise, and weight loss related interventions (Al Ansari *et al.*, 2022). However, T2DM patients cannot reach their desired blood sugar levels with lifestyle changes alone (Galindo *et al.*, 2023). Drugs, insulin, or a mix of drugs may be used for routine management and treatment. Anti-hyperglycemic drugs and non-pharmacological therapy approaches are the mainstays of more recent advancements in T2DM care, which aim to reduce consequences such as cardiovascular and renal illness (Boakye *et al.*, 2023). Because T2DM patients have intense emotions and psychological effects that necessitate extra assistance, a strategy that prioritizes patients is crucial. To reduce the risk of complications, a comprehensive strategy including lifestyle modifications, consistent medication, and ongoing monitoring is necessary (Pratley, 2013).

Compared to developed nations like the USA, T2DM is more common in South Asian nations like Pakistan at younger ages (Litchman *et al.*, 2022). Rapid lifestyle changes, increasing rates of obesity, and genetic makeup are some of the factors that lead to its development. Diabetes rates are increased by jobs that require sedentary behavior, long hours, and manufacturing labor (Hashmi *et al.*, 2021). The risk is also increased by socioeconomic status, low income, and literacy rate. Participants' awareness of DM problems is also influenced by factors such as age, sex, occupation, and family history of diabetes. Awareness is strongly influenced by gender, with men being more aware than women (Pratley, 2013). Education is another relevant factor, with higher levels enhancing better awareness. T2DM awareness is also significantly influenced by family history; patients with a family history are five times more likely to be aware of the difficulties associated with T2DM. Future healthcare planning depends on healthcare providers and the public media promoting understanding and awareness of DM problems (Belsti *et al.*, 2019; Nomali *et al.*, 2023).

An additional risk factor for type 2 diabetes is socioeconomic status, which is influenced by occupation. Risk is also associated with lower income and lesser education level; however, the reason for this has not yet been identified. In the current study, age, sex, educational level, occupation, and the family history of T2DM were found to influence the participants' awareness of T2DM complications. Apart from the age, all other aspects of this study are in line with a study that was conducted in India (Belsti *et al.*, 2019).

The study reveals a significant difference in diabetes knowledge between developed countries like the UAE and developing countries like Pakistan. In the UAE, about one-third of respondents had knowledge that diabetes is preventable (Al-Maskari *et al.*, 2013). While in Pakistan, only 48.2% believed it could be prevented. Weight loss was the most familiar side effect, with 27% of patients familiar with it. However, very few patients, visitors, and workers knew about dementia and nervous system complications. Structural knowledge of self-management of diabetes is crucial among patients with diabetes. 21.3% of people regularly checked their blood glucose levels, indicating a higher awareness of their health status compared to the general population. Non-adherence to medication and regular appointments with physicians was also low, indicating a poor perception of the disease

(Li *et al.*, 2012). Gender and disease duration also play a role in diabetes self-management practices. Differences were found between males and females in terms of basic diabetes self-management practices, such as having a glucometer at home.

The study reveals differences in diabetes self-management practices among different genders and durations of the disease. Males tend to perform better in basic diabetes self-management practices, such as having a glucometer at home (Brown *et al.*, 2004). Regular visits to the doctor, drug compliance, and a balanced diet are also significantly different. Folklore plays a significant role in societal practices, leading to a lack of responsibility towards the disease. The surge of diabetics in Pakistan indicates a need for change in attitudes towards the disease. To transform perception about healthy practices, officials need to develop a strong strategy for delivering knowledge and educate patients in ways to manage the disease. This could lead to a rapid change in the general perception of diabetes and its management in the Pakistani population.

5. CONCLUSION

Pre-diabetes and type 2 diabetes are significantly more prevalent in Pakistan than previously thought. Insufficient knowledge was possessed by the respondents and the perceptions were inadequate and subpar. Awareness programs should be launched, as these will cost less money spent on curative care if people learn how to manage diabetes, and there will be reduced strain on the healthcare system. Comprehensive strategies that incorporate T2DM screening, prevention, and treatment at the community level must be developed.

Conflict of Interest

The authors affirm that none of the work described in this publication has been influenced by any known financial or personal interests.

Authors' Contribution

Alishba Shahid: Data collection, Saba Saba: Conceptualization and supervision, Abid Hussain: Manuscript editing and revision, Laraib Saleem: Manuscript writing, Laraib Aslam: Manuscript writing

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Not Applicable.

Data availability

All data supporting the findings of this study is given in the paper.

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